

Message

From: North, Alexis [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=D24E261D2C5F490AA1247230E6198B94-NORTH, ALEXIS]
Sent: 6/28/2019 3:58:46 PM
To: Klepp, Robert [Klepp.Robert@epa.gov]
Subject: FW: Question regarding OOOOa

Per our conversation, please see my brush with OOOOa technical infeasibility in the email string below...

From: North, Alexis
Sent: Friday, November 4, 2016 10:55 AM
To: Jerry Fiore <jerry.fiore@whiting.com>
Subject: RE: Question regarding OOOOa

Jerry,

The technical infeasibility summary submitted regarding Charging Eagle 15-21A-16-4H below meets the recordkeeping requirements of 40 C.F.R. 60.5420a(c)(1)(iii)(A). I've included the regulatory text below for reference.

Sincerely,

Alexis North

Alexis North, Environmental Scientist
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§60.5420a What are my notification, reporting, and recordkeeping requirements?

(c)(1)(iii)(A)...In addition, for wells where it is technically infeasible to route the recovered gas to any of the four options specified in §60.5375a(a)(1)(ii), you must record the reasons for the claim of technical infeasibility with respect to all four options provided in that subparagraph, including but not limited to; name and location of the nearest gathering line and technical considerations preventing routing to this line; capture, reinjection, and reuse technologies considered and aspects of gas or equipment preventing use of recovered gas as a fuel onsite; and technical considerations preventing use of recovered gas for other useful purpose that that a purchased fuel or raw material would serve.

From: Jerry Fiore [<mailto:jerry.fiore@whiting.com>]
Sent: Monday, October 17, 2016 11:48 AM
To: North, Alexis <North.Alexis@epa.gov>
Subject: RE: Question regarding OOOOa

Alex:
Per our discussion on October 6th, we have put together our justification for Technical Infeasibility for the Reduced Emission Completions on the Charging Eagle 15-21A-16-4H. Please refer to the text below. I am interested in your opinion on whether you believe this meets the burden of reasonableness? I would be happy to discuss this further if you think it beneficial.

Twin Buttes Federal Exploratory Unit

Reduced Emission Completions – Technically Infeasibility Determination

Background

The Twin Buttes Federal Exploratory Unit encompasses 17,426 acres on the Fort Berthold Indian Reservation (FBIR) in Dunn County, North Dakota. Whiting Oil and Gas Corporation is the operator of the Unit which currently consists of 23 producing oil wells all producing from the Bakken and Three Forks formations. Current field-wide average production is 2,100 barrels of oil per day (bopd), 1,400 thousand cubic feet per day (mcf/d), and 2,900 barrels of water per day (bwpd). First production from the Unit occurred in 2009. Whiting has identified that up to 29 additional development wells could be drilled within the Unit at some future date. There is no existing gathering, pipeline or electric infrastructure in the field. Produced oil and water are trucked from each tank battery and produced gas not used for on-site fuel usage is flared. Whiting and its predecessor operator Kodiak O&G have attempted various pilot projects to reduce the amount of flared gas from the Unit wells but there is currently no ability to fully capture and sell or use the gas for alternative purposes.

Future Development

Under the terms of the Twin Buttes Federal Exploratory Unit, there is a 90-day continuous drilling obligation that requires Whiting to spud the next exploratory well in the Twin Buttes Unit by February 16th, 2016. The next proposed well is the Charging Eagle 15-21A-16-4H (Well API Number: 330-250-2855) located as follows:

- Surface Hole Location: S21-T147N-R92W
- Bottom Hole Location: S16-T147N-R92W

It is anticipated that the completion and first production from this well will occur in March 2017. There are no available options to capture gas on site during flowback and given the long lead times of the larger scale projects described below it is technically infeasible to conduct Reduced Emission Completion operations during flowback on this location as no gas takeaway infrastructure or alternate gas usage capability will exist in that timeframe. A flowback separator will be used and the separated gas will be routed to a flare for combustions.

Technically Infeasible

Specific to the four options addressing technical infeasibility identified under OOOOa, refer to the following:

1. Route gas into a flowline or collection system (aka gas gathering pipeline)

- a. Whiting's Twin Buttes Unit is geographically bounded to the North and West by Lake Sakakawea reducing the potential gathering systems for tie-in to those located either south or west. The nearest gathering line following a land route is the Northern Border Interconnect which is 36.7 miles south of the Unit along a proposed pipeline route. Whiting would need to build approximately eight miles of gathering pipeline within the Unit to connect the pads, construct a gas compression and processes plant and the transmission pipeline to the main line interconnect.
- b. The estimated time to build, not including acquiring ROW, is approximately 16 months. At this time Whiting does not have the necessary ROW approved to begin building the pipeline or gathering system; that process could be an additional 12 to 18 months before construction could begin. At 2,100 mcf/d, there is insufficient produced gas from the current Unit wells or from adjacent non-Unit wells (other operators) to support the construction of the required gathering system, compression and processing plant, and transmission pipeline for this type of system. Even additional produced gas resulting from full Unit development (drilling of additional wells) does not provide sufficient gas volumes to justify this system.

2. Gas capture and reinjection (for enhanced oil recovery)

As an alternate plan to traditional gas capture and pipeline take-away (Option 1), Whiting has initiated a study on the use of wet gas reinjection within the Unit as a pilot project for testing miscible gas enhanced oil

recovery. Limited laboratory testing and reservoir modeling suggest that the injection of wet, unprocessed, gas into the Bakken reservoir could theoretically enable additional Tertiary oil recovery increases of more than 1 to 2% of original oil-in-place (OOIP). Concerns and/or limitations for this process include the following:

- a. **Formation Constraints** – The targeted formation in the Unit for gas reinjection would be the Bakken Shale. Development of oil production from the Bakken is typical of the unconventional reservoir; shale gas/oil plays currently dominating North American energy production. The Bakken shale is a tight oil reservoir where the source rock and reservoir rock are one and the same. Ultralow matrix permeabilities are measured on the micro-Darcy scale. It is fracturing in the Bakken shale, both pressure-dependent natural fractures and man-made fractures induced during completion via hydraulic fracturing that creates the permeability necessary to transmit fluids at commercially viable production rates. Primary oil recovery methods from the Bakken shale will result in only 2 to 10% of the oil-in-place volumes calculated for this reservoir. Enhanced recovery methods will be required to mobilize additional production, but the contrast between matrix and fracture permeabilities in the shale may be a limiting factor in the viability of conventional fluid and/or gas reinjection due to the high probability of early breakthrough of the injected fluid/gas via the fracture network. It is quite certain that both natural and induced fractures are present in the Bakken reservoir within the Unit.
- b. **Modeling and laboratory testing are theoretical only** – Due to the nature of the Bakken as an oil reservoir (high pressure, oil-wet, high API gravity oil), laboratory testing and reservoir modeling indicate that either CO₂ or re-injected wet gas may be effective as a miscible gas tertiary oil recovery technique. The availability of the required CO₂ volumes to effectively initiate and sustain an enhanced oil recovery project in the Bakken reservoir is currently limited in the Williston Basin, but produced associated gas is available. The similarities between CO₂ and wet gas at reservoir conditions make wet gas a viable option for miscibility with the reservoir fluids. There have been several laboratory tests and reservoir modeling efforts made and results published on the theoretical effectiveness of various enhanced recovery strategies. In the field tests mentioned below the models and lab tests do not mimic the natural/induced fracture networks that exist in the Bakken reservoir and therefore are not indicative of actual results thus far. Please note the articles referenced below.
- c. **Limited Field testing** – Actual field testing of gas injection, CO₂ or natural gas, has been limited especially where results are publically available. Whiting attempted a single vertical Bakken well, CO₂ injection test in 2013 which showed immediate CO₂ breakthrough (less than 24 hours) into offset horizontal well laterals and the test project was shut down. As feared, the immediate breakthrough demonstrated that the gas was not permeating the matrix, but was finding natural and/or induced fractures and quickly flowing out to other wells. Although limited in scope, this was deemed an unsuccessful Enhanced oil recovery (EOR) test method at the time. A review of public records on the NDIC website shows that EOG conducted a field test using an existing horizontal well in Parshall Field alternating a mix of produced water and field gas for reinjection. There was documented breakthrough of fluids in less than 30 days on two offset horizontal wells that also raises concerns about the fracture breakthrough issue and eliminates the benefit of reinjection as a method of EOR.
- d. **Long lead time to build infrastructure and determine efficacy** - Specific to the Twin Buttes Unit, the installation of a pilot project in the Unit would require the construction of a 10-mile gas gathering system within the Unit and a 740HP compressor station at a selected pilot well injection site. All of the Unit produced gas would be required for reinjection in this pilot project. The regulatory and ROW processes required to install and operate this type of pilot project would involve applications and approvals from the NDIC, BLM, BIA and TAT. The time frame for all regulatory approvals is estimated to be in the 18 to 24 months range. Actual construction would add 12 to 18 months. Operation of the facility and evaluation of the results/feasibility of wet gas injection could require up to two additional years. Given those timing constraints, the availability to reinject Unit produced gas would be 30 to 42

months range with an additional 24 months possibly required in determining the success and/or feasibility of wet gas reinjection in the Unit. The scope of this type of pilot project eliminates it from consideration for any well completion required within that first 30 to 42 months.

- e. **Alternate re-injection usage** – Separate from the reinjection of produced gas directly into the reservoir is the use of the gas as an artificial fluid lift method. Using produced gas for a gas lift system is a proven method for stable fluid production. It requires a constant supply of processed gas and the infrastructure/equipment necessary to compress and reinject the gas downhole and through designed lift points/mandrels within an installed tubing string. Gas lift as an artificial lift producing method is better suited for a more stable producing well and typically not needed during an initial flowback since the new well is flowing and not technically feasible because the produced gas supply is too variable. Since the system only cycles a small amount of gas and would not continuously decrease the amount of flared gas on a location.

3. Re-use (use of produced gas for fuel)

Whiting uses as much produced gas as possible for fuel at its existing surface production and treating facilities (tank batteries). In addition to heater-treater fuel, there are currently 11 natural gas generators within the unit providing electrical power primarily to pump jack motors and submersible downhole pumps (ESP). Total on-lease gas usage (average 66 mcf/d) equates to only 2.5% of Whiting's current gas production in the Twin Buttes Unit. The wells produce more gas than we can use on the lease for fuel.

Continuous dual fuel drilling operations is not an option for the drilling of the Charging Eagle 15-21A-16-4H well. Currently there is no drilling rig operating in the field and continuous 24/7 drilling rig operation is not anticipated beyond the drilling of the Charging Eagle 15-21A-16-4H well. There is no continuous demand for the gas as rig fuel. There is also no existing field-wide gathering and compression system to deliver compressed fuel gas to a drilling site. It is planned to be a single (new) well pad with no adjacent producing wells available as a fuel gas source.

4. Other Options

Whiting looked for other beneficial uses of the produced gas. These are discussed below:

a. Electrical Generation

- i. As mentioned, small reciprocating gas generators are installed on existing producing well pads but the on-site electric demand and fuel usage is a minor amount of the total gas produced. Larger 225 Kilowatt (kW) micro turbine generators could be installed at each well pad to process and convert the full gas stream into electricity. Distribution lines would then be required to deliver the generated power to a designated point. At the current Unit gas production, it is estimated that up to 6,600 kW could be generated. A power distribution system does not exist within the Unit and would take time to obtain ROW and construct; potentially two years or more. The ability to convert and transmit electric power from these wells does exist; its ultimate use is questionable.
- ii. There is insufficient demand in the field to utilize the majority of this generated electricity. Delivering this power to an existing commercial power grid is an alternative; however, there is currently no requirement, as with non-renewable energy projects, for commercial power utilities to take this power. Electricity generated from this type of source is considered "dirty power" subject to interruptions and high harmonic loads. Unless required by regulations, the utilities will not accept it. The nearest interconnect for electrical sales would require 28 miles of transmission lines, transformers, metering and synchronizing gear.
- iii. Equipment used to convert the produced gas into electricity could result significant emissions.

b. Alternate Usage

- i. Specific to the completion of the Charging Eagle 15-21A-16-4H well, the option of catch, compress on location, and transport to sell produced gas is available however no third party has done this during flowback and question the ability to catch all gas. After multiple discussions of this option with third party vendors the general consensus is they are unable to capture the flowback gas due to the short duration and high variability of flow during flowback. It would take more time than we have during flowback operations to stabilize equipment and they question ability to work with flowback equipment with no gas venting.
- ii. Natural Gas Liquids Recovery Units- These systems have previously been installed and operated on producing wells in the Twin Buttes Unit to remove and sell the liquids from produced gas. The units are subject to operations problems, are inherently manpower intensive and do not function in a way that would abide by the new flaring regulations as approx. 60% of the produced gas is still sent to the flare as residue gas.

References

1. Enhanced Oil Recovery- B. Todd Hoffman; <http://www.aogr.com/magazine/cover-story/modeling-examines-gas-injection-results-for-improving-bakken-recovery>
2. Enhanced Oil Recovery – James A. Sorenson and John A. Hamling; <http://www.aogr.com/magazine/cover-story/historical-bakken-test-data-provide-critical-insights-on-eor-in-tight-oil-p>
3. NDIC website; <https://www.dmr.nd.gov/oilgas/>

Thank you,

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From: North, Alexis [<mailto:North.Alexis@epa.gov>]
Sent: Thursday, October 06, 2016 2:09 PM
To: Jerry Fiore
Subject: RE: Question regarding OOOOa

Hi Jerry,

I found some gems in the preamble for the federal register (click [here](#)). Starting with page 35844, last paragraph of the first column:

As the purpose of this action is to control and limit emissions of GHG and VOC, EPA seeks to confirm that all regulatory standards are met. Any owner or operator claiming technical infeasibility, nonapplicability, or exemption from the regulation has the burden to demonstrate the claim is reasonable based on the relevant information. In any subsequent review of a technical infeasibility or nonapplicability determination, or a claimed exemption, EPA will independently assess the basis for the claim to ensure flaring is limited and emissions are minimized, in compliance with the rule. Well-

designed rules ensure fairness among industry competitors and are essential to the success of future enforcement efforts.

Also, it looks like there is some recordkeeping and documentation, page 35847, middle paragraph of the first column:

For each well for which a technical infeasibility exemption is claimed, to route the recovered gas to any of the four options specified in § 60.5375a(a)(1)(ii), the report includes the reasons for the claim of technical infeasibility with respect to all four options provided in that subparagraph.

There is a whole "Technical Infeasibility" section on page 35850, but it doesn't really seem to add or subtract from our conversation here, but FYI.

More on "REC Feasibility", page 35852, middle column, last paragraph and I haven't read it all but I skimmed and seems to work with our plan here.

Thanks for your patience as I muddled through.

Alex

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From: Jerry Fiore [<mailto:jerry.fiore@whiting.com>]
Sent: Thursday, October 06, 2016 1:08 PM
To: North, Alexis <North.Alexis@epa.gov>
Subject: RE: Question regarding OOOOa

Alex:
Would you be available this afternoon to talk?

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From: North, Alexis [<mailto:North.Alexis@epa.gov>]
Sent: Thursday, September 29, 2016 4:48 PM
To: Jerry Fiore
Subject: RE: Question regarding OOOOa

Sorry Jerry, I'm out in the field this week. Maybe next week?

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From: Jerry Fiore [<mailto:jerry.fiore@whiting.com>]
Sent: Thursday, September 29, 2016 1:06 PM
To: North, Alexis <North.Alexis@epa.gov>
Subject: Question regarding OOOOa

Alex:
Do you have time this afternoon for a call to discuss a OOOOa questions?

Regards,

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